(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 256 316 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.11.2002 Bulletin 2002/46

(51) Int Cl.[7]: **A61B 5/22**, G01C 22/00, A63B 22/00

(21) Application number: **01201653.1**

(22) Date of filing: **07.05.2001**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

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Remarks:
A request for correction of Figures 1A and 2A has been filed pursuant to Rule 88 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 3.).

(54) Portable device comprising an acceleration sensor and method of generating instructions or advice

(57) The invention pertains to a portable device comprising a housing, a display, a storage medium, at least one acceleration sensor, means for calculating an activity parameter based on the signal generated by the acceleration sensor, storing the calculated parameter in the storage medium, and showing the same in the display. The said parameter is the Physical Activity Index (PAI) or a derivative thereof.

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Description

[0001] The invention pertains to a portable device comprising a housing, a display, a storage medium, at least one acceleration sensor, means for calculating an activity parameter based on the signal generated by the acceleration sensor, storing the calculated parameter in the storage medium, and showing the same in the display. The invention further pertains to a method of generating instructions or advice on how to increase physical activity as well as to a computer program comprising program code means for performing all the steps of the said method.

[0002] An example of a device as described above is known from e.g. United States Patent 5,788,655, which relates to an exercise amount measuring device. This particular device calculates and displays total consumed calories, a remaining target calorie value, and a life activity index, which is classified into e.g. one of three ranks (I 'light', II 'medium', and III 'a little heavy'). To calculate these parameters, gender, age, height, and weight should be inputted by means of switches on the device.

[0003] Nowadays, many people are aware of the importance of healthy nutrition and sufficient exercise, yet appear unable to accomplish the same.

[0004] It is an object of the present invention to provide a device which stimulates (daily) physical activity through relatively uncomplicated and user-friendly means.

[0005] To this end, the device according to the invention is characterised in that the said parameter is the Physical Activity Index (PAI) or a derivative thereof.

[0006] It was surprisingly found that the PAI can be established readily, because the relation between the PAI and a processed signal or samples of a signal of the acceleration sensor is substantially linear. PAI can be established for instance by subtracting an offset from the processed signals or sample and multiplying the result with a constant. Such a constant is preferably determined by measuring the oxygen consumption of several subjects. Personal data of a user, such as gender, age, height, and weight, need not be inputted thus further enabling straightforward construction and enhancing ease of use. Also, the PAI is universal in that e.g. a PAI of 1.5 indicates a sedentary lifestyle independent of personal data, i.e. for a woman in her early twenties and a middle-aged man alike. Thus, suitable instructions or advice on how to increase physical activity can be readily selected based on the measured PAI and competition between e.g. colleagues or family members is being provoked.

[0007] It is preferred that the device comprises an input/output connector which enables the transfer of at least some of the stored information to a computer that contains or is connected or connectable to an electronic database and/or an electronic algorithm.

[0008] The method of generating instructions or advice according to the invention involves electronically obtaining, from an individual, the Physical Activity Index (PAI) or a derivative thereof and selecting, based on this parameter, one or more instructions or advice components from a database. It is preferred that the said parameter is downloaded by a remote server system, which selects, based on this parameter, one or more instructions or advice components from a database and wherein the selected items or a processed version thereof are subsequently uploaded.

[0009] The invention further pertains to a computer program comprising program code means for performing all the steps of this method. The computer program product may of course comprise both modules intended for implementation on a remote service system, e.g. located at a service provider, and modules intended for implementation on a local processing unit, such as a personal computer and/or portable computer device of some sort.

[0010] The Physical Activity Index (PAI), sometimes also referred to as Physical Activity Level (PAL), can be established by dividing the Total Energy Expenditure (TEE), i.e. the amount of energy that is consumed by a person during a selected period of time, e.g. a day, by the Basal Metabolic Rate (BMR), i.e. the amount of energy that is consumed by a person lying still on a bed for the same period of time. Typically, the PAI has the value of 1.0 when the person is lying on a bed, 1.5 when the person leads a sedentary life and 2.0 when the person has an active lifestyle.

[0011] The invention will now be explained with reference to the drawings in which a preferred device and method according to the present invention are schematically depicted.

[0012] Figures 1A to 1C show respectively a front, rear and side view of a portable device according to the present invention.

[0013] Figures 2A and 2B show a cradle for receiving the device according to figure 1B.

[0014] Figure 3 is a block diagram of electrical circuitry for use in the device according the invention.

[0015] Figure 4 is a block diagram of preferred electrical circuitry for use in the device according the invention.

[0016] Figure 5 is a flowchart of a website where the method according to the invention has been implemented.

[0017] Figures 1A to 1C show a preferred embodiment of the device according to the present invention, which embodiment will be referred to as activity monitor 1. The activity monitor 1 comprises a injection moulded housing 2 of a thermoplastic material such as PBT, an Liquid Crystal Display (LCD) 3, and four buttons 4 to 7. The rear side of the monitor comprises a bayonet catch 8 engaging a clip 9 for attaching the monitor 1 to an item of clothing and a cavity for accommodating a battery, which cavity is closed by means of a cover 10. It further comprises three I/O connectors, in this case butt con-

tacts 11, 11', 11' which, upon placing the monitor in a complementary cradle, e.g. a docking station 12 shown in Figures 2A and 2B, contact three connectors 13, 13', 13' in the docking station 12 and enable the transfer of information, e.g. by means of an RS-232 protocol, between the monitor 1 and a computer to which the docking station 12 is connected.

[0018] The LCD 3 features the time, the numerical value of the Physical Activity Index (PAI) averaged over one or more selectable periods of time, and a segmented bar to graphically display the PAI within a specific range, e.g. from 1.0 to 3.0, in a number of discrete steps, e.g. of 0.1.

[0019] Instead of PAI, derivatives of PAI, such as (PAI - 1) x 100, can be employed. When using this particular derivative, a value of 0 means that the user has been at rest (at least for the selected period of time for establishing PAI), whereas a value of e.g. 100 indicates an active lifestyle.

[0020] Buttons 4 to 7 serve to display and adjust time (respectively button 4 and buttons 5/6) and switch between displaying the PAI over e.g. the last day and the last week (button 7).

[0021] Figure 3 shows a block diagram of an electrical circuitry for use in the activity monitor 1. The circuitry in this example comprises a single one-dimensional accelerometer 14, e.g. a so-called uniaxial piezo-electric accelerometer, which registers body movement of a wearer of the monitor 1 in the longitudinal direction or the antero-posterior and longitudinal directions. To achieve the latter, the accelerometer 14 is positioned at an angle of approximately 45 degrees to a horizontal position (as shown in figures 1A and 1B) of the monitor 1. The aforementioned clip 9 in figure 1C facilitates attachment of the monitor 1 to e.g. the belt of a wearer in such a way as to ensure a substantially horizontal position during most of the time, especially when the wearer is standing upright. As a matter of course, it is also possible to employ e.g. three sensors 14 (as depicted by dotted lines).

[0022] The accelerometer 14 generates, dependent on the movements of a wearer, which typically occur in a frequency range from 0.5 to 16 Hz and with an amplitude of less than 5G, an analogue signal, e.g. a voltage fluctuating in a range from 0mV to 10mV. This signal is subsequently amplified by means of amplification circuitry 15 and converted to a digital sequence of numbers by means of an A/D converter 16 with a sample frequency of e.g. 32 Hz. A dedicated microprocessor 17 calculates a so-called running average of the absolute value of the acceleration data over e.g. the last day and the last week. The running average is calculated by adding the absolute value of the most recent sample to an accumulated sum and subtracting the average of this sum over the selected period of time. The average of the accumulated sum over the selected period of time equals the running average. To obtain the PAI the running average is multiplied by a metabolic factor reflecting the average oxygen consumption of relatively large number of experimental subjects and a sensor calibration factor.

[0023] Thus, to calculate the average value of the PAI over a certain period of time, e.g. a day, the signal can be processed e.g. as follows. The absolute value of the signal, which fluctuates within the said range of from 0mV to 10mV, is amplified by an amplification factor and sample by the A/D converter 16, which then generates a sample value e.g. an integer in a range from 0 to 255. Subsequently, the running average of the sample values is calculated and multiplied by a metabolic factor, which can be established by comparing the said running average with true PAI values obtained by measuring oxygen consumption in one or more subjects in a manner which is known in itself. It is further preferred to employ a calibration factor to compensate for variations specific to the sensor in hand. For piezo-electric sensors variations were found to be $\pm$ 20% and, accordingly, the calibration factor is preferably in a range from 0.8 to 1.2.

[0024] The microprocessor 17 stores the calculated PAIs in a memory 18, such as a random access memory chip, and shows the information, selected by the wearer by means of the appropriate button 4, in the display 3.

[0025] Figure 4 comprises an advantageous embodiment, wherein the circuitry comprises a rectifier 19 which comprises four diodes and an operational amplifier and is connected to the output of the amplifier 15. An integrator 20, which comprises a capacitor circuit, is connected to the output of the rectifier 19 and accumulates the analogous signal from the same. Instead of sampling the acceleration at a relatively high rate of e.g. 32 Hz, one can now reduce this rate to e.g. 1 Hz and, accordingly, significantly lower the power consumption of the activity monitor 1 and extend battery-life. A further advantage resides in that the PAI can be established with a high accuracy even when an low accuracy A/D converter (e.g. 8 bits) is being used.

[0026] Although the activity monitor 1 can be used as a stand-alone entity, which provides its user with accurate information of his or her activity, either relative to past activity of the user himself or relative to that of other people e.g. by means of the table or chart reflecting typical PAIs for specific persons (in terms of e.g. profession, sport, age, gender etc.), it is preferably used in conjunction with a personal computer (PC) and/or a remote computer, e.g. a server system. In that case, the user can compare his or her PAI with that of numerous other users and automatically select instructions or advice components from a database or calculate a new PAI goal by means of an algorithm.

[0027] To this end, the docking station 12 is connected to a PC or a remote server system in which software has been installed which preferably recognises the presence of the activity monitor in a known manner and performs a number of actions, e.g. download a 32-bit unique identification code, download last docking date, download PAI values of e.g. the last months, synchronise the clock of the activity monitor 1 and that of the PC or server system, and upload the present docking

date.

[0028] A flowchart of a preferred website, which is installed on the said server system and which can be accessed via the Internet by the user with a web browser, such as Microsoft Explorer or Netscape Navigator or similar (future) means, is depicted in figure 5 and comprises a home page 0.0. This home page 0.0 shows several menus, which provide access to subpages of the website concerning, inter alia, the host, products of the host, health issues, registration, and login. The remainder of the home page 0.0 may comprise news items, advertisements, pictures, and the like.

[0029] A personal coach page 1.0 forms the kernel of the website. This page 1.0 can be accessed via a registration page 1.1 or login pages 1.8 and 1.9. The former page 1.1 comprises an electronic form for gathering information from users of the activity monitor 1 who visit the website for the first time. Such information may comprise the name, address, city, country, weight, height, age, gender, and weight goal, and will be used by the personal coach page 1.0 to generate instructions and personalised advice. The registration page 1.1 further provides a username and password, which enables users to by-pass registration page 1.1 and enter the personal coach page 1.0 directly through login pages 1.8 and 1.9, and links the username information to the aforementioned unique address code. During login, the system compares the downloaded ID to the ID in the server so as to provided automatic login. The last docking date and most recent PAI values are used to update the database.

[0030] The personal goals of a user of the activity monitor 1 in terms of a desired activity level and a desired weight are calculated on a personal goals page 1.7. Such calculations can be based on the personal data of the customer, e.g., weight, height, age, and gender, as well as on other personal parameters that can be changed and/or updated on a preferences page 1.4 and/or on the average PAI of the first week and/or a numerical parameter representing the motivation of the customer and determined by means if a questionnaire page 1.6. Upon approval of the user, the calculated goals are set to be reached at the end of a coacing period of e.g. six months. During this period, the personal coach page 1.0 provides information concerning the personal history of the user in terms of activity and body weight and advice comprising suggestions on a preferred PAI selected on selector page 1.5 and activities required to reach the set personal goals, e.g. half an hour of walking every day or 5 km running every day.

[0031] Finally, the website comprises a links page 2.0 containing links to interesting pages that can help reach the personal goals, such a as a link to go to a page containing recipes which support a healthy lifestyle, a link to a service providing direct access to an instructor or dietician, and a link containing information on regional activities. If a goal is reached, the personal coach page 1.0 may start another page, which shows a message congratulating the user or sends an actual congratulations post card to the users' address. A special printer on the system could do this automatically.

[0032] The invention is not restricted to the above described embodiments which can be varied in a number of ways within the scope of the claims. For instance, the display device can be equipped with a rechargeable battery or even means for generating energy, such as a (piezo)electric generator which converts movement into electrical energy.

Claims

1. Portable device (1) comprising a housing (2), a display (3), a storage medium (18), at least one acceleration sensor (14), means (17) for calculating an activity parameter based on the signal generated by the acceleration sensor (14), storing the calculated parameter in the storage medium (18), and showing the same in the display (3), **characterised in that** the said parameter is the Physical Activity Index (PAI) or a derivative thereof.

2. Portable device (1) according to claim 1, wherein the Physical Activity Index or a derivative thereof is calculated by multiplying an average of a processed signal or samples of a signal of the acceleration sensor (14) with at least one constant.

3. Portable device (1) according to claim 2, wherein the said average is at least multiplied by a metabolic factor.

4. Portable device (1) according to claim 2 or 3, wherein the said average is at least multiplied by a calibration factor which depends on the sensor (14).

5. Portable device (1) according to any one of the preceding claims, wherein the device (1) further comprises a rectifier (19) for rectifying the signal generated by the acceleration sensor (14) and a capacitor (20) which is charged by the rectified signal.

6. Portable device (1) according to any one of the preceding claims, wherein the device (14) comprises an input/output connector (13, 13', 13") which enables the transfer of at least some of the stored information to a computer that contains or is connected or connectable to an electronic database and/or an electronic algorithm.

7. Portable device (1) according to any one of the preceding claims, wherein the device (1) comprises a clip (9) for attaching the device (1) to an item of clothing, such as a belt, of a wearer such that rotation of the device (1) with respect to the wearer is substantially avoided and wherein the sensor (14)

is positioned at an angle in the range from 30 to 60 degrees to the horizon when the wearer is standing upright.

8. A method of generating instructions or advice on how to increase physical activity and tailored to objective needs and/or preferences of an individual, which method involves electronically obtaining a parameter concerning that individual and selecting, based on the said parameter, one or more instructions or advice components from a database, wherein the said parameter is the Physical Activity Index (PAI) or a derivative thereof.

9. Method according to claim 8, wherein the said parameter is uploaded to a remote server system, which selects, based on this parameter, one or more instructions or advice components from a database and wherein the selected items or a processed version thereof are subsequently downloaded.

10. A computer program comprising program code means for performing all the steps of claim 8 or 9 when said program is run on a computer.

11. A computer program product code means stored in a computer readable medium for performing the method of claim 8 or 9 when said program product is run on a computer.

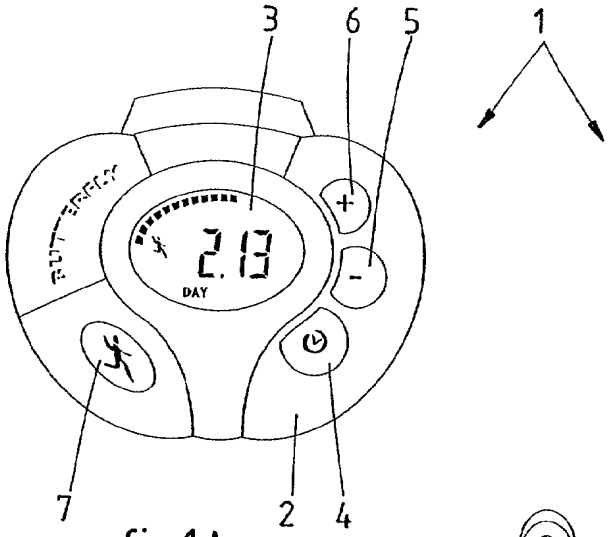

fig.1A

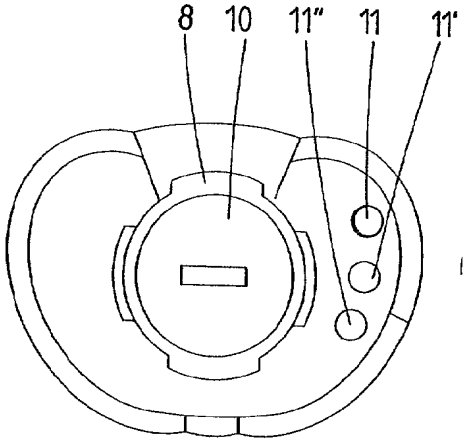

fig.1B

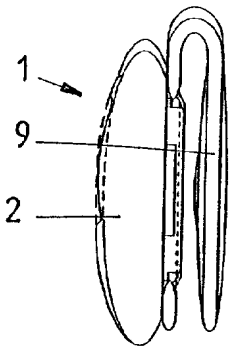

fig.1C

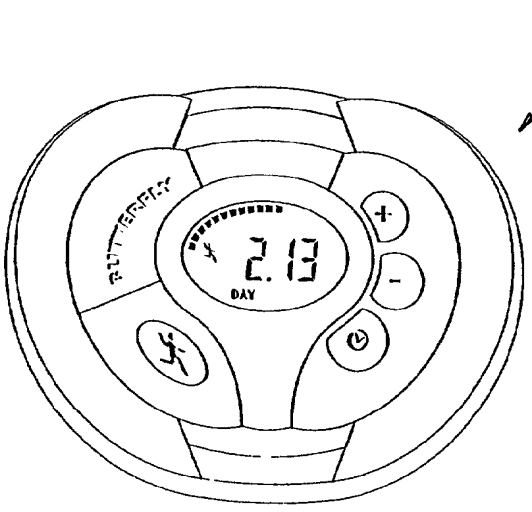

fig.2A

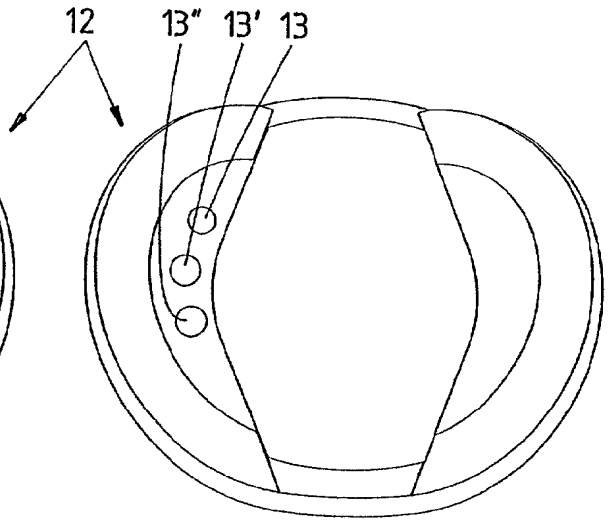

fig.2B

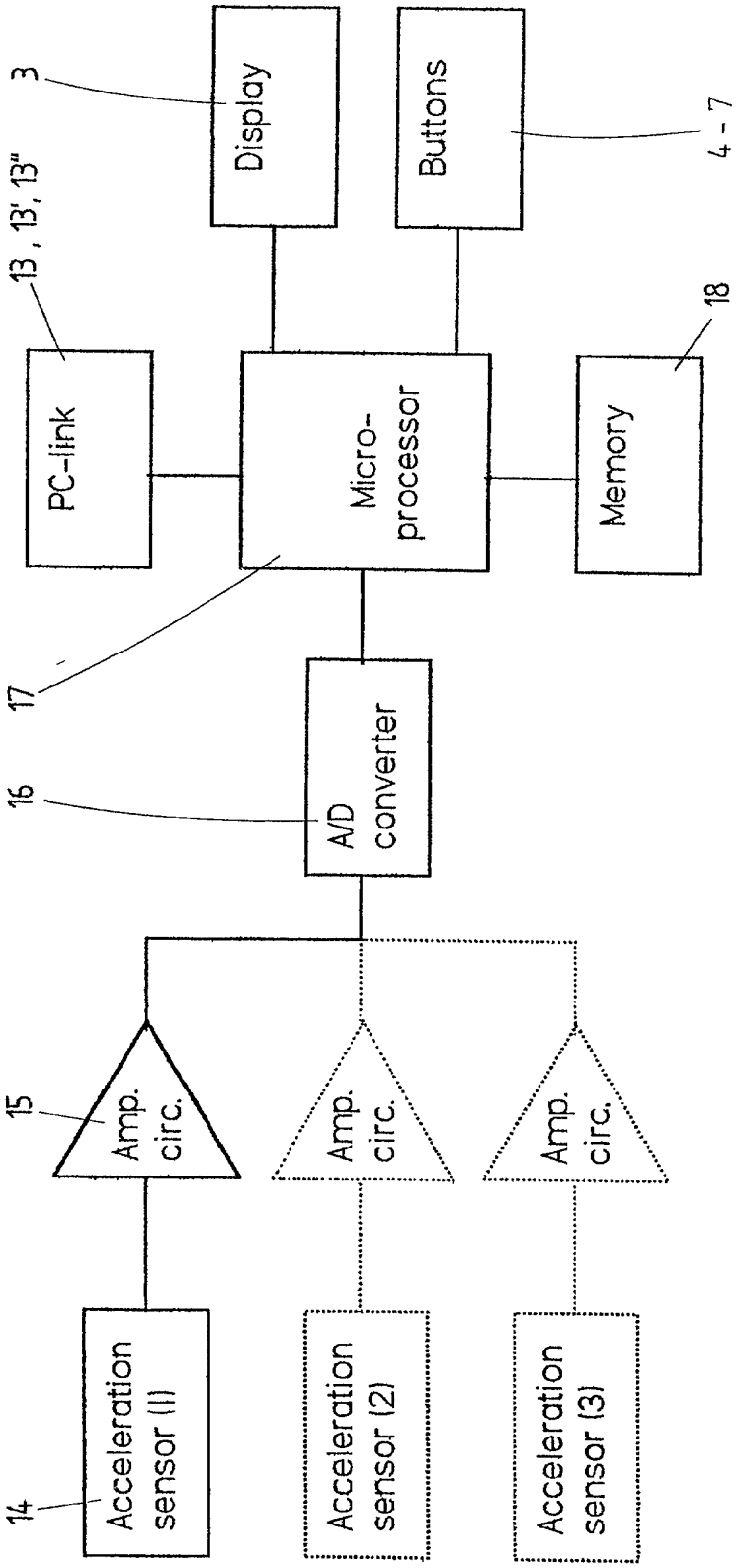
3
Display
Buttons
4 - 7
13 , 13', 13"
PC-link
Micro-
processor
18
Memory
17
16
A/D
converter
15
Amp.
circ.
Amp.
circ.
Amp.
circ.
14
Acceleration
sensor (1)
Acceleration
sensor (2)
Acceleration
sensor (3)

fig.3

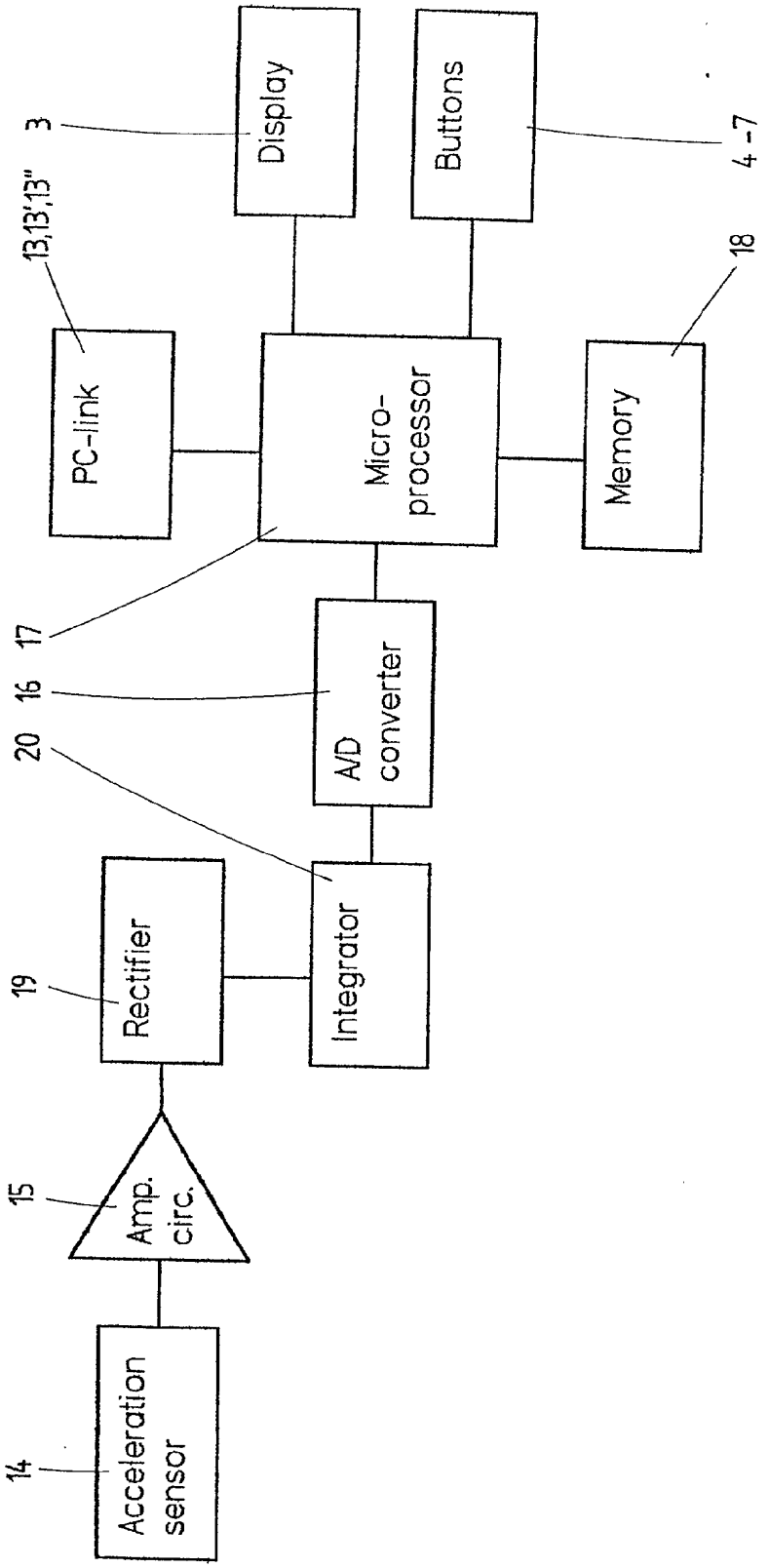
Display
Buttons
3
4 -7
13,13',13"
PC-link
Micro-
processor
Memory
18
17
16
A/D
converter
20
Integrator
Rectifier
19
15
Amp.
circ.
Acceleration
sensor
14

fig. 4

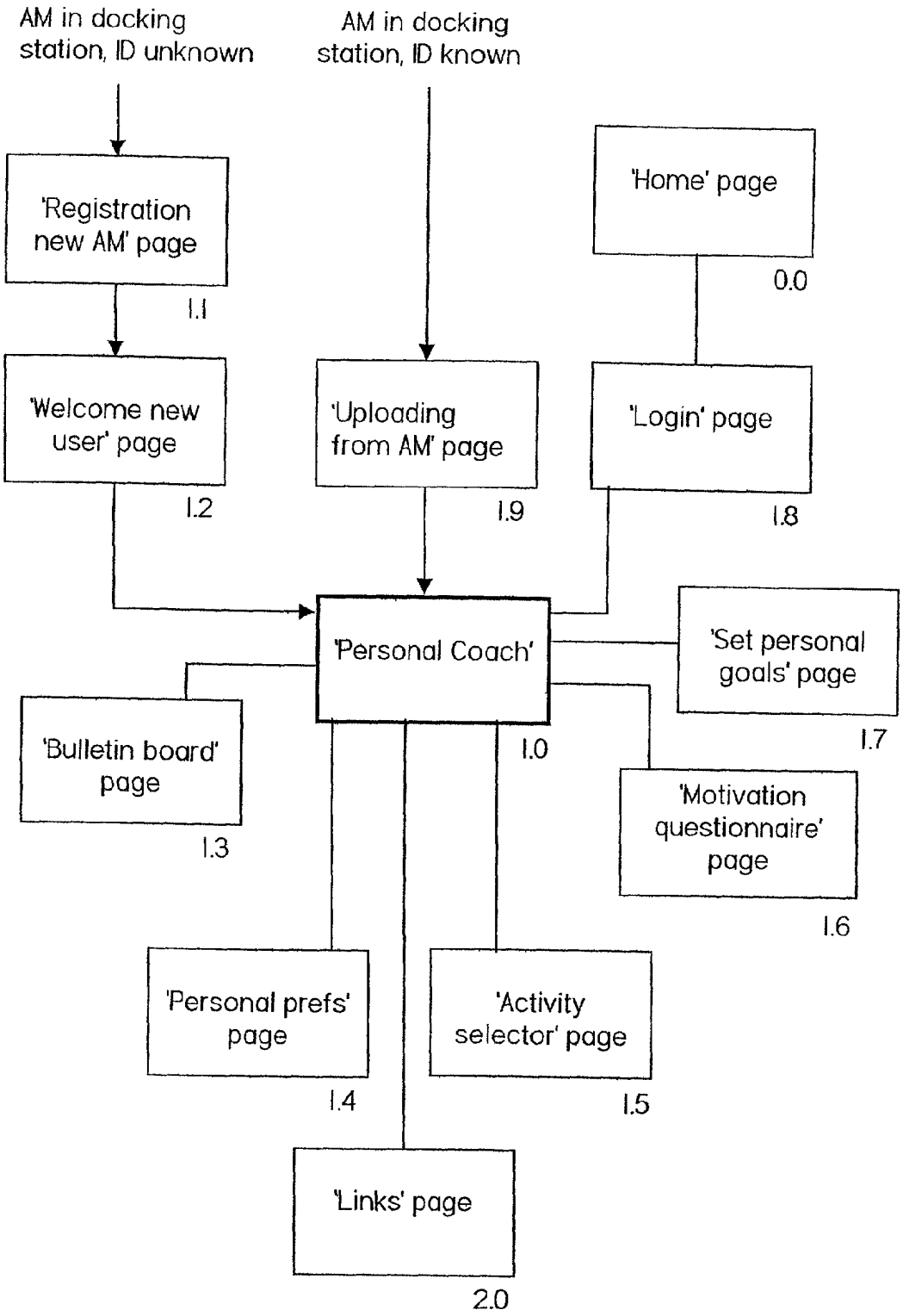
AM in docking station, ID unknown
AM in docking station, ID known
'Registration new AM' page
1.1
'Home' page
0.0
'Welcome new user' page
1.2
'Uploading from AM' page
1.9
'Login' page
1.8
'Personal Coach'
1.0
'Set personal goals' page
1.7
'Bulletin board' page
1.3
'Motivation questionnaire' page
1.6
'Personal prefs' page
1.4
'Activity selector' page
1.5
'Links' page
2.0

fig.5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 20 1653

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 6 135 951 A (WADE TED D ET AL) 24 October 2000 (2000-10-24) * column 5, line 49-53 * * column 28, line 15-26 * * column 30, line 10-30 * * figures 2,12 *	1-3,8-11	A61B5/22 G01C22/00 A63B22/00
Y		6,7	
Y	WO 96 29007 A (WALKER DAVID JOHN) 26 September 1996 (1996-09-26) * abstract; figures 1-3 * * page 15 *	6,7	
X	EP 0 797 169 A (OMRON TATEISI ELECTRONICS CO) 24 September 1997 (1997-09-24) * abstract; figures 22,23 * * page 9, line 7-40 *	1-3	
X	US 5 989 200 A (HASEGAWA MAKI ET AL) 23 November 1999 (1999-11-23) * column 2, line 4-16 * * column 2, line 29-42 * * figures 1-5 *	1-3	
X	WO 00 52604 A (STAYHEALTY COM) 8 September 2000 (2000-09-08) * page 6, line 23 - page 7, line 27; figure 1 *	8-11	
X	US 5 976 083 A (WADE TED D ET AL) 2 November 1999 (1999-11-02) * column 5, line 1-59; figure 2 *	8-11	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

A61B
G01C
A63B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	24 September 2001	Jonsson, P.O.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technolog cal background
O : non-written disclosure
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 20 1653

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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24-09-2001

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82